CLAIMS

What Is Claimed Is:

1. A video compression method for maximizing a throughput of digitized video data on a link between a digital solid-state imaging device and a host computer, comprising the steps of:

performing the luminance (Y) domain compression of the video data on a line-by-line basis without storing video data lines or video data frames; and

performing the chrominance (Cr/Cb) domain averaging of the video data on a region-by-region basis without storing video data frames,

wherein said Y and Cr/Cb domain compression steps are implemented in the digital solid-state imaging device hardware for real time link transmission of the compressed video data to the host computer.

2. The video compression method of claim 1 wherein the link is a bandwidth-limited USB bus, and the digital solid-state imaging device is an USB-based camera which comprises a pixel processing controller with a low gate count, and is adapted to be small, inexpensive, and capable of transferring 30 video frames per second.

3. The video compression method of claim 1 wherein the step of the Y domain compression comprises the following steps:

determining a value of a threshold for detecting a change in the luminance value between pixels in a video line;

tagging pixels in the video line on a pixel-by-pixel basis, according to differences in their luminance values, said tagging step comprising the following steps:

calculating the absolute value of a difference between an incoming pixel luminance value and a previously tagged pixel luminance value, and

8. The video compression method of claim 7 wherein the step of calculating the single average value for the plurality of Cb locations comprises the following steps:

averaging four-by-four adjacent Cb values from a region to generate a single intermediate average Cb value for each said four Cb values; and

averaging the intermediate average Cb values to obtain a single average Cb value.

9. The video compression method of claim 1 wherein the digital solid-state imaging device is chosen from a group which consists of office automation digital linear sensors, digital fingerprint detectors, digital scanners, digital broadcast television, compact disk video, multimedia, video teleconferencing systems, dynamic medical imaging devices, high definition TV, video cassette recorders, copy machines, and fax machines, and said bus is chosen from a group which consists of computer buses, network channels, wire optical fibers, and broadcast channels.

10. The video compression method of claim 1 further comprising the steps of:

encoding the compressed data with a minimum number of bits; and

concatenating the bits of the codes representing the compressed data, wherein said concatenation is performed separately in the Y domain and in the Cr/Cb domain, and the encoding and concatenating steps are performed before the transmission to the host computer.

11. The video compression method of claim 1 wherein said step of concatenation in the Cr/Cb domain produces alternative Cr-only lines and Cr/Cb lines, where each Cr-only line has only Cr values, and each Cr/Cb line has alternating Cr and Cb values.

if the absolute value of the difference exceeds the threshold value, saving the incoming pixel luminance value as a new tagged pixel luminance value and the number of pixels since the previously tagged pixel as a length; and

transmitting the new tagged pixel luminance value and length to the host computer.

4. The video compression method of claim 1 further comprising a step of transforming the Cr/Cb data to YCbCr 4:2:0 or 4:2:2 format, said step adapted to be performed before the Cr/Cb domain compression step.

5. The video compression method of claim 1 wherein the step of the Cr/Cb domain compression comprises the following steps:

calculating a single average value for a plurality of Cr locations;

calculating a single average value for a plurality of Cb locations; and

transmitting the average Cr and Cb values to the host computer.

SUB B1 6. The video compression method of claim 5 wherein the step of calculating the single average value for the plurality of Cr locations comprises the step of obtaining a single Cr value for each four Cr values in the 4:2:0 format, and obtaining a single Cr value for each eight Cr values in the 4:2:2 format.

7. The video compression method of claim 5 wherein the step of calculating the single average value for the plurality of Cb locations comprises the step of obtaining a single Cb value for each sixteen Cb values in the 4:2:0 format, and obtaining a single Cb value for each thirty-two Cb values in the 4:2:2 format.

SUB A2

12. In a digital video imaging device which works in the YCbCr 4:2:0 or 4:2:2 format and is attached to a host computer via a link, a pixel processing controller comprising:

a Y domain compression module for tagging pixel locations in the Y domain according to a predetermined criteria;

a Cr/Cb domain compression module for averaging the Cr and the Cb values in the Cr/Cb domain;

in the Y domain a predetermined threshold value for detecting a change in the luminance value between pixels in a video line; and

in the Y domain a predetermined value for maximum number of pixels allowed between the tagged pixels.

13. The controller of claim 12 wherein the link is a bandwidth-limited USB bus, the digital video imaging device is a solid-state USB-based camera, and the pixel processing controller has a low gate count, and is adapted to be small, inexpensive and capable of transferring 30 video frames per second.

14. The controller of claim 12 wherein the link is a bandwidth-limited bus with isochronous pipes, the digital video imaging device is a solid-state camera working in isochronous traffic mode, and each bus pipe transmits one domain per pipe.

15. The controller of claim 12 wherein the predetermined threshold value and the predetermined value for maximum number of pixels allowed between the tagged pixels are supplied by the host computer.

16. The controller of claim 12 wherein:

the Y domain compression module is adapted to determine pixels in a video line which should be tagged on a pixel-by-pixel basis, according to the predetermined criteria based on the differences in pixel luminance values; and

the imaging device transmits the tagged pixel luminance values and lengths in the video line between the tagged pixels to the host computer.

17. The controller of claim 12 wherein the Cr/Cb domain compression module is adapted to calculate a single average value for a plurality of Cr locations and a single average value for a plurality of Cb locations, the compressed data are encoded with a minimum number of bits, and the bits of the codes representing the compressed data are concatenated separately in the Y domain and in the Cr/Cb domain, before the transmission to the host computer.

SUB B2

18. The controller of claim 12 wherein the Cr/Cb domain compression module is adapted to obtain a single Cr value for each four Cr values, and a single Cb value for each sixteen Cb values in the 4:2:0 format, and a single Cr value for each eight Cr values, and a single Cb value for each thirty-two Cb values in the 4:2:2 format.

19. A digital imaging device attached to a host computer via a link, comprising:

an image sensor array for obtaining luminance (Y) and chrominance (Cr, Cb) values of pixels in a video line; and

a pixel processing controller having:

a Y domain compression module for tagging pixel locations in the Y domain, and

a Cr/Cb domain compression module for averaging the Cr and the Cb values in the Cr/Cb domain.

20. The digital imaging device of claim 19 wherein said link is a bandwidth-limited bus with isochronous pipes, wherein a first bus pipe transmits the Y domain values and a second bus pipe transmits the Cr/Cb domain values, and the digital imaging device is a solid-state camera working in isochronous traffic mode in the YCbCr 4:2:0 or 4:2:2 format.

21. The digital imaging device of claim 20 wherein:

the Y domain compression module is adapted to determine pixels in the video line which are tagged on a pixel-by-pixel basis, according to differences in the pixel luminance values;

the camera transmits to the host computer the tagged pixel luminance values and lengths between the tagged pixels; and

the Cr/Cb domain compression module is adapted to calculate a single average value for a plurality of Cr locations, and a single average value for a plurality of Cb locations.

SUB B3

22. The digital imaging device of claim 21 wherein:

the Cr/Cb domain compression module is adapted to obtain a single Cr value for each four Cr values, and a single Cb value for each sixteen Cb values in the 4:2:0 format, and a single Cr value for each eight Cr values, and a single Cb value for each thirty-two Cb values in the 4:2:2 format;

said compressed data are encoded and codes are concatenated separately in the Y domain and in the Cr/Cb domain, before the transmission to the host computer; and

said concatenation in the Cr/Cb domain produces alternative Cr-only lines and Cr/Cb lines, where each Cr-only line has only Cr values, and each Cr/Cb line has alternating Cr and Cb values.